National Institute of Environmental Health Sciences

Modelling the non-linear multiple-lag effects of ambient temperature on mortality in Santiago and Palermo: A constrained segmented distributed lag approach

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Abstract:

Objectives: Exposure to ambient temperature can affect mortality levels for days or weeks following exposure, making modelling such effects in regression analysis of daily time-series data complex. Methods: We propose a new approach involving a multi-lag segmented approximation to account for the non-linear effect of temperature and the use of two different penalised spline bases to model the distributed lag of both heat and cold exposure. Compared with standard splines, the novel penalised framework is more flexible at short lags where change in coefficients is greatest, and selection of the maximum lag appears substantially less important in determining the overall pattern of the effect. Results: Applying the approach to daily mortality in Santiago (Chile) and Palermo (Italy), we observed a heat effect that was mostly immediate and followed by negative estimates consistent with short-term mortality displacement (harvesting). Cold effects were mostly positively sustained and more evenly distributed across the 60-day analysis period: in Santiago we estimated an overall increase in deaths of 2.36% (95% CI 0.26% to 4.51%) in the 65+ age group associated with every 1°C decrease below the cold threshold, and an increase of 1.11% (0.09% to 2.14%) per 1°C for Palermo. Heat effects for Palermo were much larger than for Santiago, and less harvesting of heat deaths was evident. The estimated heat thresholds were higher in Palermo than in Santiago. Conclusions: Our approach provides a flexible and precise method to quantify health effects of both heat and cold exposure at individual lags and to model the overall pattern of the delayed effect.

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Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Temperature

Geographic Feature:

resource focuses on specific type of geography

None or Unspecified

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Europe, Central/South America

European Region/Country: European Country

Other European Country : Italy

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Injury

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Outcome Change Prediction

Population of Concern: A focus of content

Population of Concern: ☑

populations at particular risk or vulnerability to climate change impacts

Elderly

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Short-Term (

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content